Use of Benchmarking for Better Process Overview & Control

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Abstract:

Benchmarking is one of the continuous quality improvement techniques for products, processes and services. The use of benchmarking is increasing day by day in the mills. The present paper presents how benchmarking can be useful for getting performance status of a mill or industry. With benchmarks, it is possible to compare two different organizations producing different varieties of a product at the same platform. In the present work, better benchmarking has been suggested in place of ‘per capita paper consumption’ and ‘secondary fiber utilization’, to describe the environmental consciousness of a nation. The quality and profitability advantages obtained after benchmarking implementation have also been indicated here.

Introduction:

Benchmarking is a rapidly emerging tool for process and quality control as well as for cost reduction. Deciding a target and comparing oneself based on available information with other organizations in the similar field is called benchmarking. Comparison to other becomes important in many ways; consider a mill that has reduced its specific water consumption from 100 KL/T of paper to 40 KL/T of paper within a year. We can say the mill has done a wonderful job. But, what if some other mill of the same type is using water to the tune of only 8-10 KL/T of paper.

Unfortunately, due to lack of sufficient information, we are able to hide many of our weaknesses. The mill using 40 KL/T water may justify that they are producing quality

paper, so they need more water; or the quality changes are frequent hence water consumption is more. Similar considerations can be made for specific power consumption, specific manpower requirement, specific chemical consumption, specific steam consumption etc.

Being it a newer subject to most of the paper mills, some benchmarks have been offered here for ready use. Once in use, these may be modified to have a better idea over the process performance.

Benchmarking Tools:

The benchmarking may be of two types- single parameter & multiple parameters. As the name implies, single parameter considers single values, e.g. specific power consumption for different varieties of product, specific chemical consumption for different lot sizes, or qualities etc. While, multiple parameter benchmarking compares averaged operational data for a period of time with other mills. As it is difficult to collect detailed data from other mills easily, this type of benchmarking compares mainly the averaged values.

Before going into much detail, one is normally interested in comparing ones data with that of others. Such tools could be specific water, power, and raw material or chemical consumption. But, the product mix of one mill is normally different from another. If a mill is producing different varieties of paper, obviously, no single value can be taken for any benchmarking parameter but, comparing the data averaged over a month (normally a calendar month) could make a fairly good comparison with that of others.

Such benchmarks are often used to compare between two mills, segments or even countries. The following example shows such data-

Specific Water Consumption for different mills
(Single parameter benchmarking)

Mill	Water Consumption (KL/T)	Type of Mill (With/Without Recovery)	Size of Mill TPD	Sp. Power Consumption KWH/T
#1	47	Agro Based, No Rec.	60	700-800
#2	85	Agro Based, With rec.	100	1000-1200
#3	120	Agro/Wood Based, Rec.	180	1200-1400
#4	26	Recycled Fiber Based	30	500-700

These data, to a certain extent give a vague overview of the parameter concerned. While in use frequently, these fail to give adequate information, and cannot be treated as a barometer in real sense. In the example above, one may call Mill-3 the most deficient, while; this may be using another raw material than Mill-4. Thus, we cannot compare the performance of an agro based integrated paper mill with a secondary fiber based mill.

Another following example shows the ridicularity involved in such benchmarking norms-

Country	Per Capita Paper Consumption** (Kg.)	Waste Paper Utilization* (%)	Per Capita Virgin Fiber Consumption (Kg)
Malaysia	87	83	14.8
China	26	37	16.4
India	8	32	05.4
Indonesia	18	54	08.3
US	232	65	81.2
Global	51	45	28.1

(*Ref: Misra, J.P., IPPTA 13(3): 61 (Sept. 2001)
** Ref: 38th All India Paper Traders Conference, 1999, New Delhi.)

- Virgin Fiber utilization has been calculated as follows-

VFC = Per Capita Consumption * (100- % waste paper Utilization) / 100

- The actual number of mills producing paper and boards is not authentically known and is quite often disputed, thus the actual production of different grades of paper and board is not really clearly known.

In the above data, we may see that this benchmark has posed India to be on a lower side, indicated by lowest per capita consumption of paper as well as less dependence on waste paper. Now, we may review the situation under following points-

1. 15-20% of paper is practically not recoverable. This includes grades such as library books, food packaging, cinema posters etc. Another 25% is again not recoverable because it is either far away from mills, or becomes very weak or is uneconomical to use. This includes varieties of government office records, bank and post office records, where records are stored for years.
2. India is an importer of secondary fiber, while; the countries like US, Canada etc. export their secondary fiber to India.
3. A significant part of population in India uses wastepaper for other secondary uses. Paper bags made of old newspapers are used for selling daily groceries etc. The basic reason behind this is the moral values in India that discourage any wastage.
4. If we consider a new benchmark, (VFC, as indicated above), we can place India on a much better position. Even considering 100% literacy level in India, it is expected that increased production will be met mainly by virgin fiber. Still the figures show that VFC for India would be lesser than the world average, and thus VFC presents a better overview of the situation.

In view of the above discussion, we would find that the per capita consumption of paper in India should be higher than reported earlier. Also, waste paper utilization figure would be somewhat higher than that reported above. This will, of course, not affect the VFC, and hence again, we may consider VFC a better benchmark. If we are concerned with cutting of trees and forests for making paper, we must count on VFC.

With this benchmark, India emerges as the most eco-friendly country in the above table.

Single Parameter Benchmarking:

Single parameter benchmarking is important, as it is required to compare parameters between two products. Using data for different products, with the mathematical tools it is possible to have benchmarks for different products based on quality, quantity, time etc. In a particular case, mill had collected good amount of data on specific power consumption. But, the data were varying. On discussion with the plant personnel, it was pointed out that the lower grammage paper results in less production rate and hence increased specific power consumption, as many motors operate on almost same load, e.g. vacuum pump, fan pump, fresh water pump etc. They also pointed out that specific power consumption was more for the months when the lower grammage product was made in more percentage.

In a typical case, to develop a relation between gsm and specific power consumption (SPC), data were analyzed and following equation was obtained-

$$SPC = X - Y\ (gsm)$$

Based on this equation, data for different months were analyzed, and it was observed that there was a slight decline in SPC with time. It indicated that the plant personnel were interested in reducing SPC.

This analysis later on helped in another way. When the pulp mill was modified, and installation of new equipments was made, a reduction in SPC was observed. Analysis as discussed above could be used to quantify the benefits of the changes made. Now, the mill has developed an internal standard based on gsm for SPC daily monitoring. With this system any increase in SPC can be pointed out within 24 hours and corrective action can be taken.

Multiple Parameter Benchmarks:

Benchmarks, which are based on single element, are often inaccurate in describing total plants performance. For example, in a mill producing strawboard, the management removed all drive belts from stock chest agitators, just to save electricity. This resulted in variation of consistency, and hence grammage variation resulting in price reduction of their product, which they realized later after few months and reverted back to the earlier situation. A step ahead, in another paper mill, a consultant suggested to stop aerators at least in night, to reduce the power consumption for effluent treatment, which is really a wrong practice as per pollution norms.

Many a people feel benchmarking improper, as it is often difficult to find a similar mill for comparing the data. If the type of mill is different, process is different, product mix is different or production capacity is different, the data are not comparable as shown in table-1.

If we consider energy consumption, one may ask “Are small mills more efficient?” obviously not. The reason is that the small mills use a different process other than the

big mills. Not only this, SPC may vary within a particular category. Obviously, mills producing quality paper have to use more specific power than the mills producing inferior grades. Also, a mill using better raw material needs lesser power compared to another mill producing same product but with inferior product. The similar is the case for Japan. We know, Japan has a very low SPC, and seems efficient from this perspective. But, we should also consider the fact that Japan is a country, where most of the paper is made from recovered fiber, and hence SPC is lower. This justifies need for development of a power consumption benchmark better than conventional SPC; which is independent of mill size and process used.

A proposed benchmark for power consumption thus can be written as under-

$SPC_{bm} = SPC * P_{rm} / P_{pr}$

Where, subscript $_{rm}$, $_{pr}$ and $_{bm}$ stand for raw material, product and benchmark; and P stands for payments made or received in rupees for raw material and product. SPC considers grid power; self-generated power with DG set or turbines using steam made of purchased fuel, but excludes power generated by steam from chemical recovery boilers. Where DG sets are being used, instead of measuring power by meters, a standard conversion of say 3.8 KWH/lit. HSD may be used. This will eliminate manipulation of data by tempering with energy meters to show use of lesser energy, and shall also encourage considering using efficient DG sets in place of lesser efficient ones. Elimination of power generated by steam from chemical recovery boiler from this procedure is expected to encourage installation of chemical recovery units. As per new regulations, all the agro based paper mills have been advised to go for chemical recovery units by 2004 or close. Furthermore, this cogeneration of power is helping in protecting the environment. Thus, large and small paper mills can be considered on an equal platform on performance.

Objectives Behind Benchmarking:

It is possible to use the benchmarks for process efficiency control, quality control etc. here, a few cases are presented where such objects could be achieved by benchmarking.

Case 1 (Quality Improvement):

The paper mills commonly monitor their machine runnability with average joints. For this, the number of joints made in producing rolls of paper, are divided by the number of rolls made. This leads to confusion many a times as if out of 10 rolls, there is one roll with 10 joints, and balance rolls are with nil joint the average joint would be considering as one only in all the rolls. This led to find a suitable way for monitoring machine runnability on a rational basis.

A formula has been proposed below to describe the machine runnability numerically, for rationalizing the above problem.

Description:

This index is based upon joints in different rolls, and average weight of rolls made over a specified period. The index approaches to 1 if number of nil joint rolls is more, and to 0 if joints are more in rolls. The index can be calculated using the following formula-

Index = AVERAGE [1-(Joint(s)/(Joint(s)+1))]

Here, it has been considered the fact that the runnability would be better for 10% rolls with 2 joints, and others being with nil joint, rather than that for the case where 20% rolls have one joint and balance are with nil joint. As an example, runnability index was calculated for different data sets having nil, one and two joints, which is given hereunder-
Basis: 100 Rolls

Nil Joint	One Joint	Two Joints	Avg Joints	Index
100	0	0	0	1.000
0	100	0	1.000	0.500
25	50	25	1.000	0.583
50	0	50	1.000	0.667

The above table clearly justifies that value of average joints does not fulfil the purpose of evaluation of machine runnability and runnability index can be more successfully used for such evaluations.

If the concept is rationally applied, the effect of different chemicals, process parameters etc. can be evaluated properly. It was observed that some of the chemicals were used unnecessarily hoping to get better machine runnability, while they were not actually improving the machine runnability. As a result, the application of these chemicals was discontinued. Also, display of machine runnability index was provided on the machine floor. This encouraged the machine crew to be more attentive towards better runnability, and hence productivity.

Case 2 (Productivity & Efficiency Improvement):

In a large paper mill, to improve the workers efficiency, the management was running a scheme of production incentive. This scheme worked out production incentive as per the following formula-

Incentive = (Production-A) * B

Where, A and B are constants. To encourage the workers further, a notice board was placed at the mill entrance, so that the workers may note down the daily and up-to-date production. This led to better preventive maintenance, more productivity and much better working environment in the mill.

Within a couple of years, management introduced another incentive scheme for the reduction of electrical power. Now the workers were getting additional benefits if

they were able to produce same quantity of product with lesser amount of electricity. Now, the incentive was-

Incentive = (Production-A) * B + (C * Reduction in SPC than Norm)

Here, we may notice another aspect of such implementations. In the first scheme, an operator is interested only in production, as a result, he takes no chance. During a visit to this mill, it was found that the machine chest agitators were running, even when the machine was shut for one hour. While discussed with operators, they were afraid that a slight stoppage of agitators might result in consistency fluctuation and hence production loss. Later on after implementation of second scheme, as the power consumption also became the concern of operators, they took more interest in understanding of process and fully cooperated in different energy conservation programs. The above example shows that proper on job training and due incentives lead to more productivity and profitability in the organization.

Case 3 (Manpower Policy):

Often it is heard that annual production per employee is very low in India. This infers that a mill producing same quantity of product but with lesser employees is more efficient. This has to evaluate with reference to size of the mill and techno-economic considerations of that mill to achieve the desired quality levels. Against this, in a typical case, for a small mill, manpower was increased 20% than the conventional one. All of the increase was made in quality control department. Within a few months, quality improved drastically, and the product became comparable to the best mills with complete automation consisting of DCS & QCS systems etc. After around a year, a comparative study showed that the investment on increased employees was less than the interest for investment that required if the mill was made fully automatic for that size of the mill. Here again, it seemed that conventional benchmarks did not solve the purpose. But, after a few years, when there was a major expansion in production capacity of the same mill, automation became important due to process and quality requirements. After this automation, manpower requirement reduced drastically in that area. Finally, VRS was offered to reduce more number of employees.

Conclusion:

Benchmarks can be very effectively and efficiently used for improvement in productivity and profitability. The basic requirement is a proper selection of benchmark, which can be done easily. This has been indicated in examples shown above indicating VFC to be better indication of nation's commitment towards better environment, rather than secondary fiber utilization. Similarly, Machine Runnability Index gives better overview of machine runnability than average joint gives. The application of benchmarking has been found very useful in all the cases.